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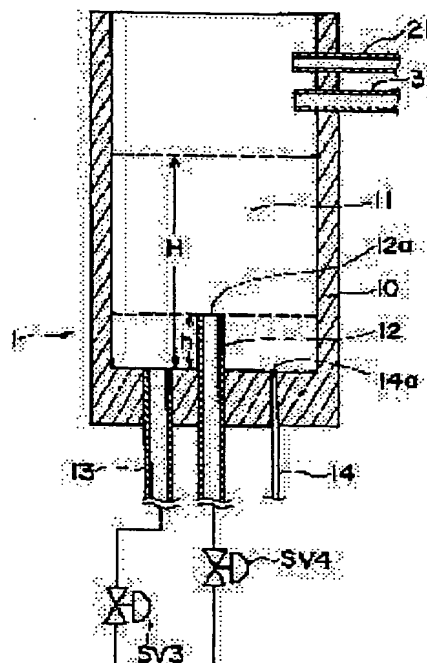
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(54) DILUTING TANK AND DILUTING DEVICE USING IT

(57)Abstract:

PROBLEM TO BE SOLVED: To simplify a structure, miniaturize it, and attain high repetitive reproducibility by measuring and diluting a sample and a diluent with one diluting tank.

SOLUTION: A sample is fed to a dilution chamber 11 while a solenoid valve SV3 is closed and a solenoid valve SV4 is opened. When the height of the liquid level reaches the protruded height (h) of a sample discharge pipe 12, the fed sample starts to be discharged to the outside from a sample discharge port 12a through the sample discharge pipe 12, then the feed of the sample is stopped, and the solenoid valve SV4 is closed. The volume of the sample is set to V_h . A diluent is fed into the dilution chamber 11, and a color former is also fed as required. When the liquid level height reaches the prescribed height H, the feed of the diluent is stopped, and the volume of this liquid is set to V. Compressed air is jetted into the dilution chamber 11 from an air injection hole 14a through an air feed pipe 14 to stir the sample and diluent in the dilution chamber 11. The diluted sample diluted to V_h/V is prepared. The solenoid valve SV3 is finally opened, and the prepared diluted sample is taken out through a diluted sample discharge pipe 13.



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[0005]

This apparatus, as shown in Fig. 15, has a first measuring tank 2' that measures a sample so as to obtain a set quantity, a second measuring tank 3' that measures pure water for use in diluting the sample so as to obtain a set quantity, a mixing tank 1' that mixes the sample measured in the first measuring tank 2' and the pure water measured in the second measuring tank 3' to prepare a diluted sample, a measuring tank 5' that measures a concentration of a particular component contained in the diluted sample, and a drain discharging pipe 51' that discharges outside the diluted sample after the concentration of the above-mentioned component is measured with the measuring tank 5'. To a bottom of the first measuring tank 2' and a bottom of the second measuring tank 3' are connected a sample supplying pipe 21' that supplies the measured sample to the mixing tank 1', and a pure water supplying pipe 31' that supplies the measured pure water to the mixing tank 1', respectively, and the above-mentioned sample supplying pipe 21' and the pure water supplying pipe 31' join into one flow to be led to the mixing tank 1'. The above-mentioned sample supplying pipe 21' and the pure water supplying pipe 31' have valves V1 and V2 in the middle thereof, respectively. Furthermore, to a bottom of the mixing tank 1' is connected a diluted sample discharging pipe 13' that discharges the diluted sample, and another end of this diluted sample discharging pipe 13' is connected to the measuring tank 5'. To the measuring tank 5' is further

connected a drain discharging pipe 51' that discharges the diluted sample after the measurement has been completed. A valve V3 is provided in the middle of the above-mentioned diluted sample discharging pipe 13'.

Moreover, a valve V4 is also provided in the middle of the above-mentioned drain discharging pipe.

[0006]

A sample such as circulating water in a thermal power plant and an atomic power plant is led to the first measurement tank 2', and is measured so as to obtain a set quantity. After the sample is measured in the first measurement tank 2', the above-mentioned valve V1 opens, and the measured sample is introduced into the mixing tank 1 through the sample supplying pipe 21'.

[0007]

On the other hand, the pure water for use in diluting the above-mentioned sample is led to the second measuring tank 3' and is measured so as to obtain a predetermined quantity. After the pure water has been measured in the second measuring tank 3', the above-mentioned valve V2 opens and the measured pure water is introduced into the mixing tank 1' through the pure water supplying pipe 31'.

[0008]

The sample and the pure water introduced into the mixing tank 1' are stirred and mixed by stirring means provided in the above-mentioned mixing tank 1', which is not shown in the figure, to thereby prepare the diluting. Furthermore, a color former that forms a color in response to a component to be measured is infused into the mixing tank 1' through a

constant rate pump not shown in the figure.

[0009]

After the diluted sample has been prepared in the mixing tank 1', and the above-mentioned color former has been infused into this diluted sample, the valve V3 opens to introduce the diluted sample into the measuring tank 5' through the diluted sample discharging pipe 13' and in the measuring tank 5', the concentration of the above-mentioned component is measured by means of colorimetric measurement or the like. The diluted sample after being measured in the measuring tank 5' is discharged as a drain through the drain discharging pipe 51'.

[0030]

In the diluting tank of the aspect shown in Figs. 1 and 2, the shape of the diluting chamber is a cylindrical shape, but is not limited to the cylindrical shape. As the shape of the diluting chamber, in addition to the cylindrical shape, for example, an inverted conical shape, truncated conical shape, or the like is usable. Alternatively, a cylindrical shape with a bottom formed into an inverted conic surface, rectangular cylindrical shape, truncated pyramid shape, or the like is also possible. A shape such as a spherical shape and an ellipsoidal shape, and a shape with a constriction such as a gourd shape are also possible.

[0031]

Furthermore, a part of the above-mentioned diluting chamber may be a constant volume chamber having a predetermined inner volume and

opening upward. In the case where the constant volume chamber is provided in a part of the diluting chamber, the constant volume chamber is preferably provided at a bottom of the diluting chamber, and an area of the opening that the constant volume chamber has is preferably smaller than a cross sectional area in a horizontal direction that the above-mentioned diluting chamber has at an upper portion than the constant volume chamber. The configuration of the constant volume chamber as described above allows a higher dilution ratio to be obtained in the diluting tank of the same volume. Moreover, since the small area of the opening of the constant volume chamber results in small shaking of the liquid level, constant volume error due to shaking can be reduced.

[0032]

As the sample discharging means, the sample discharging pipe that discharges the sample exceeding the predetermined quantity outside can be used. As the sample discharging pipe, like the sample discharging pipe of the above-mentioned diluting tanks, there can be used a pipe projecting from the bottom, that is, the lowest portion of the diluting chamber upward and having at an upper end thereof an opening oriented upward or laterally. Here, as the pipe having the opening oriented laterally at the upper end, for example, a pipe curved into an inverted L-shaped as a whole can be exemplified. Also, as the sample discharging pipe, a siphon pipe can be used. Particularly in the case where the siphon pipe is used as the sample discharging pipe, the measured sample does not flow out of the diluting tank through the sample discharging pipe after the measurement has been completed, which allows higher precision dilution. Here, as the siphon pipe,

a pipe curved into an inverted U shape or J shape can be exemplified. In the case where the sample discharging pipe projecting from the bottom, that is, the lowest portion of the diluting chamber upward and having at the upper end thereof the opening oriented upward or laterally is used, the use of a pipe with a small diameter for the sample discharging pipe can reduce the error due to the sample left in the sample discharging pipe, which is preferable.

[0033]

Moreover, as the sample discharging means, a sample discharging hole drilled in a wall surface of the above-mentioned diluting tank body is preferable. A sluice or pipe may be connected to an opening of the above-mentioned sample discharging hole outside of the diluting tank body so that the sample spilling out of the above-mentioned opening does not flow down on the outer wall of the diluting tank.

[0034]

However, in these sample discharging pipes, the height h of the opening must be lower than the above-mentioned height of the diluting chamber. Moreover, in the case where the sample supplying pipe and the diluting solution supplying pipe, which will be described later, are provided, the height of the above-mentioned opening is also preferably lower than that of the opening of either of these sample supplying pipe and diluting solution supplying pipe. Furthermore, in the case where a part of the above-mentioned diluting chamber is the constant volume chamber, the height of the opening is preferably the same as the height of an upper end of the above-mentioned constant volume chamber.

[0035]

Here, the height of the opening refers to a height of an opening end itself in the case where the sample discharging means is the sample discharging pipe, and the opening of this sample discharging pipe opens upward or downward, and refers to a height of a lowest end of the opening in the case where the opening of the sample discharging pipe is oriented laterally. Moreover, in the case where the sample discharging means is the sample discharging hole drilled in the wall surface of the diluting tank body, the height refers to a height of a lowest end of the sample discharging aperture opening in an inner wall of the diluting chamber.

[0036]

In the case where the sample discharging pipe is used as the sample discharging means, a valve can be provided as the sample discharge stopping means in the middle of the sample discharging pipe. As the valve, various forms of valves can be used, and as such a valve, for example, a stop valve, gate valve, butterfly valve, ball valve, three-way valve, faucet and the like can be exemplified. These valves may be of a manual type, may be a valve actuated by electromagnetic power such as an electromagnetic valve, or may be a valve actuated hydraulically or pneumatically. Alternatively, a pinchcock may be used instead of the above-mentioned valves.

[0037]

On the other hand, in the case where the sample discharging hole is used as the sample discharging means, an opening and closing plate attached in the vicinity of the sample discharging aperture opening in the wall surface of the above-mentioned diluting chamber, which opens and

closes the above-mentioned sample discharging aperture, can be used as the sample discharge stopping means. Furthermore, in the case where the pipe is connected outside of the sample discharging hole, as in the sample discharging pipe, a valve can be inserted as the sample discharge stopping means in the middle of this pipe. For the valve, valves similar to those of the sample discharging pipe can be used.

[0038]

The diluting tank may further have various types of stirring means.

[0039]

As such stirring means, there is stirring means utilizing a stirring action of a gas injected into a liquid. As such stirring means, for example, like the stirring means shown in Figs. 1 and 2, there is stirring means for stirring the sample and the diluting solution within the diluting chamber by injecting a gas such as air into the diluting chamber from a gas jetting aperture provided at the bottom of the diluting chamber. The gas injected from the above-mentioned gas jetting aperture may be any gas that substantially does not dissolve in, and react to, the sample and the diluting solution. As such a gas, air and an inert gas such as nitrogen gas and argon gas, can be exemplified.

[0040]

As the stirring means, otherwise, stirring means for stirring by irradiating an ultrasonic wave is used. As such stirring means, for example, there is stirring means in which an ultrasonic wave oscillator is provided on the inner surface of the diluting chamber or on the surface of the diluting tank body. In this stirring means, the sample and the diluting solution

within the diluting chamber are stirred by the ultrasonic wave irradiated from the above-mentioned ultrasonic wave oscillator.

[0041]

Furthermore, as the stirring means, mechanical stirring means such as a propeller type stirrer, turbine type stirrer, and reciprocating rotary stirrer is preferably used.

[0042]

As a material of the diluting tank body, any material to which high-precision processing can be applied and that does not impinge on the sample and the diluting solution can be used. As such a material, stainless steel, phosphorus bronze, aluminum bronze, beryllium bronze, high nickel steel, nickel base high corrosion-resistant alloy, ceramics, glass, various synthetic resins, and the like can be exemplified. In addition, different materials can be used for the bottom and the side of the diluting tank body. However, in the case where means by which a liquid level is optically detected is used as liquid level detecting means as described later, it is preferable that light transmits through the side of the diluting tank body, and thus, the side of the diluting tank body is preferably composed of a transparent material such as various types of glass, acrylic resin, polycarbonate resin, and hard polyvinyl chloride resin.

[0062]

The procedure for preparing the diluted sample using the diluting tank 1 shown in Figs. 5 and 6 is shown below.

[0063]

First, with the electromagnetic valve SV3 closed and the electromagnetic valve SV4 opened, the sample is supplied to the diluting chamber 11. The sample is stored in the diluting chamber 11 and thus, the liquid level rises until the height of the liquid level measured from the bottom of the diluting chamber 11 becomes equal to the height h of the constant volume chamber 11a. Then, when the height of the liquid level within the diluting chamber 11 reaches the above-mentioned height h , the supplied sample is discharged outside from the sample discharging aperture 12a through the sample discharging pipe 12, so that the sample is not stored in the diluting chamber 10. Thus, the height of the liquid level does not exceed the height h of the constant volume chamber 11a. When the sample starts to be discharged from the pipe 12c, the supply of the sample is stopped and the electromagnetic valve SV4 is closed. Here, if the volume of the constant volume chamber 11a is V_h , the volume of the sample at this time is also V_h .

[0064]

Subsequently, the diluting solution is supplied into the diluting chamber 11, and further, a color former that forms a color in response to a component to be measured is supplied as necessary. When the height of the liquid level within the diluting chamber 11 reaches the predetermined height H higher than the height h , the supply of the diluting solution is stopped. The volume of the liquid existing in the diluting chamber 11 at this time is V .

[0065]

After stopping the supply of the diluting solution, compressed air is

supplied through the air supplying pipe 14, this compressed air is jetted into the diluting chamber 11 from the air injecting hole 14a, and the sample and the diluting solution within the diluting chamber 11 are stirred. By this, the diluted sample obtained by diluting the original sample at V_h/V with the diluting solution has been prepared.

[0066]

Finally, the electromagnetic valve SV3 is opened and the prepared diluted sample is taken out through the diluted sample discharging pipe 13.

[0067]

Fig. 7 is a perspective view showing one example of the diluting tank in which the sample discharging pipe 12 is a siphon pipe in each of the diluting tanks shown in the Figs. 5 and 6, and Fig. 8 is a cross sectional view showing a longitudinal plane when cutting the diluting tank shown in Fig. 7 along a plane A-A.

[0068]

The diluted liquid discharging pipe 13 that discharges the diluted liquid prepared in the diluting chamber 11 is attached to the bottom of the diluting tank body 10 as in the diluting tanks shown in Figs. 5 and 6, and in the middle of the diluted liquid discharging pipe 13, the electromagnetic valve SV3 is provided.

[0069]

The air supplying pipe 14 is further attached to the bottom of the diluting tank body 10, the upper end of which is the air jetting hole 14a

[0070]

The sample supplying pipe 21 and the diluting solution supplying

pipe 31 penetrate an upper portion of the diluting tank body 10, as in the above-mentioned diluting tanks.

[0071]

In the diluting tank 1 shown in Fig. 7, the diluting tank body 10 and the diluting chamber 11 also have shapes similar to those of the above-mentioned diluting tanks, and are formed of transparent acrylic resin. The formation of the constant volume chamber 11a at the bottom of the diluting chamber 11 is also similar. Furthermore, the shape, diameter and height of the constant volume chamber 11a are also similar to those of the constant volume chamber in the above-mentioned diluting tanks.

[0072]

A siphon pipe attaching hole 12B₁ that attaches a siphon pipe 12A in a horizontal direction toward the inside of the wall of the diluting tank body 10 from the above-mentioned conic surface 11b is drilled. A vertical hole 12B₂ is drilled through the inside of the wall of the diluting tank body 10 in a vertical direction so as to meet the above-mentioned siphon pipe attaching hole 12B₁ at right angles. A portion where the above-mentioned siphon pipe attaching hole 12B₁ and the vertical hole 12B₂ cross is a crossing portion 12B₃ which is a cubical space one side of which is larger in length than a diameter of the siphon pipe attaching hole 12B₁ and a diameter of the vertical hole 12B₂. One end of the siphon pipe 12A is inserted into the siphon pipe attaching hole 12B₁ and the other end thereof is a pipe curved downward. The opening 12a of the siphon pipe 12A opens downward at the end of the siphon pipe 12A that is curved downward, and has substantially the same height h as the height of the upper end of the constant volume

chamber 11a. The discharging pipe 12C that discharges the sample outside is inserted into the vertical hole 12B₂, and the electromagnetic valve SV4 is provided in the middle of the discharging pipe 12C. In this diluting tank, the siphon pipe 12A, siphon pipe attaching hole 12B₁, vertical hole 12B₂, crossing portion 12B₃, and discharging pipe 12C correspond to the sample discharging pipe 12.

[0073]

While the liquid sample that can be diluted in the diluting tank of the present invention includes circulating water and the like in a thermal power plant and an atomic power plant, for example, not only these samples but a sample obtained by sampling in a chemicals factory, pharmaceuticals factory, food factory or the like is included. Moreover, various waste liquids discharged from factories, and a non-aqueous sample such as hydrocarbon fuel oil and lubricant is included in the above-mentioned liquid sample.

[0074]

As the diluting solution, if the liquid sample is aqueous, service water, pure water and ion-exchanged water are used. If the liquid sample is non-aqueous, various organic solvents are used. The organic solvent used as the diluting solution can be selected from the group consisting of aliphatic hydrocarbon solvent, aromatic hydrocarbon solvent, halogenated aliphatic hydrocarbon solvent, halogenated aromatic hydrocarbon solvent, alcohol solvent, ether solvent, amine solvent, amide solvent such as dimethylformamide, and pyrrolidone such as N-methylpyrrolidone, according to properties of the sample.

[0075]

Next, the diluting apparatus of the present invention is described.

[0076]

Fig. 9 is a piping diagram showing one example of the diluting apparatus of the present invention.

[0077]

In the diluting apparatus shown in Fig. 9, the diluting tank 1 has the same aspect as the diluting tank 1 shown in Figs. 7 and 8. More specifically, the entire diluting tank body 10 is composed of acrylic resin, and a part of the diluting chamber 11 formed inside of the diluting tank body 10 is the constant volume chamber 11a. The sample discharging pipe 12 penetrates a lower portion of the diluting tank body 10. The sample discharging pipe 12 has the siphon pipe 12A, and the opening 12a of the siphon pipe 12A has substantially the same height as that of the upper end of the constant value chamber 11a. The electromagnetic valve SV4 is provided in the sample discharging pipe 12, and a detector 6 is provided downstream from the electromagnetic valve SV4 of the sample discharging pipe 12. This detector 6 is a detector that optically detects that the sample has passed through the sample supplying pipe 12. The detector 6 is electrically connected such that when the sample discharged from the sample discharging pipe 12 is detected, the electromagnetic valve SV1 provided in the sample supplying pipe 21 described later is closed.

[0078]

At the upper portion of the diluting tank 1, the sample supplying pipe 21 that supplies the sample to the diluting chamber 11 and the diluting solution supplying pipe 31 that supplies the diluting solution to the diluting

chamber 11 are provided. The other ends of the sample supplying pipe 21 and the diluting solution supplying pipe 31 are connected to a sample storing tank 2 and a diluting solution storing tank 3, respectively. Here, the sample storing tank 2 is a container that temporarily stores the obtained sample, and the diluting solution storing tank 3 is a container that stores the diluting solution. The electromagnetic valves SV1 and SV2 are inserted in the middle of the sample supplying pipe 21 and the diluting solution supplying pipe 31, respectively. In the above-mentioned diluting solution supplying pipe 31, a shunt pipe 32 that shunts the diluting solution supplying pipe 31 to the diluted sample discharging pipe 13 described later is branched from the electromagnetic valve SV2, and an electromagnetic valve SV6 is provided in the middle of the shunt pipe 32.

[0079]

The diluted sample discharging pipe 13 is connected to the bottom of the above-mentioned diluting chamber 11. The diluted sample prepared within the above-mentioned diluting chamber 11 is taken out of this diluted sample discharging pipe 13. The electromagnetic valve SV3 is provided in the middle of the diluted sample discharging pipe 13.

[0080]

In the diluting apparatus shown in Fig. 9, this diluted sample discharging pipe 13 is connected to a measuring tank 5, and in the measuring tank 5, the concentration of a predetermined component in the above-mentioned diluted sample, for example, phosphoric ions, is measured. The measuring tank 5 is incorporated on an optical path of a colorimetric photometer not shown in the figure. In the colorimetric photometer, light

rays emitted from a light source are received by a light receiving part through the measuring tank 5. In the measuring tank 5, there is further provided a drain discharging pipe 51 that discharges the diluted sample after being measured outside of the diluted apparatus. An electromagnetic valve SV7 is provided in the drain discharging pipe 51.

[0081]

A light source 41 and a light detector 4 that detects light from the light source 41 are provided outside of the diluting tank body 10. The light detector 4 is provided on the opposite side of the light source 41 across the diluting tank body 10, and the position of the above-mentioned light detector 4 is adjusted so that the light emitted from the light source 41 directly enters the light receiving part of the above-mentioned light detector 4. The light source 41 and the light detector 4 are installed so that a light path R is positioned at the height H from the bottom of the constant volume chamber 11a. The light detector 4 and the electromagnetic valve SV2 are configured to link to each other, so that the light from the light source 41 is cut off and a light detecting signal from the light detector 4 becomes 0, thereby closing the electromagnetic valve SV2.

[0082]

The air supplying pipe 14 is further attached to the bottom of the constant volume chamber 11a, and this air supplying pipe 14 is connected to a compressed air tank 7. An electromagnetic valve SV5 is provided in the middle of the air supplying pipe 14.

[0083]

In the diluting tank 1, in addition to the foregoing, a color former

that forms a color in response to the component to be measured, for example, when the above-mentioned component is phosphoric ions, piping that supplies ammonium vanadate solution and ammonium molybdate solution is provided, which is not shown in the Fig. 9.

[0084]

In the diluting apparatus of Fig. 9, the diluting tank 1 corresponds to the diluting tank in the diluting apparatus of the present invention. The sample storing tank 2 and the sample supplying pipe 21 correspond to the sample supplying means in the diluting apparatus of the present invention, and SV1 corresponds to the sample supply stopping means in the diluting apparatus of the present invention. The diluting solution storing tank 3 and the diluting solution supplying pipe 31 correspond to the diluting solution supplying means 31 in the diluting apparatus of the present invention, and V2 corresponds to the diluting solution supply stopping means in the diluting apparatus of the present invention. The diluted sample discharging pipe 13 and the electromagnetic valve SV3 correspond to the diluted sample discharging means and the diluted sample discharge stopping means in the diluting apparatus of the present invention, respectively.

[0085]

Hereinafter, the operation of the diluting apparatus shown in Fig. 9 is described.

[0086]

Fig. 13 is a flowchart showing a flow of the operation of the diluting apparatus shown in Fig. 9. The diluting apparatus of Fig. 9 is in a state

where all the electromagnetic valves SV1 to SV7 are closed before the start of dilution.

[0087]

First, the electromagnetic valve SV1 provided on the sample supplying pipe 21 and the electromagnetic valve SV4 provided on the sample discharging pipe 12 open to supply the sample to the constant volume chamber 11a of the diluting tank 1. The sample stored in the storing tank 2 flows down into the constant volume chamber 11a through the sample supplying pipe 21 and the electromagnetic valve SV1. When the liquid level of the sample in the constant volume chamber 11a reaches the upper end of the constant volume chamber 11a, which is at the height h , the opening 12a of the sample discharging pipe 12 and this liquid level come into contact, and after this, the supplied sample is discharged through the sample discharging pipe 12. The state of the diluting apparatus shown in Fig. 9 at this time is shown in Fig. 10. When the detector 6 provided in the sample discharging pipe 12 detects the discharged sample, the electromagnetic valve SV1 is first closed by the signal from the detector 6, and the electromagnetic valve SV4 is subsequently closed, by which the supply of the sample is stopped.

[0088]

When the supply of the sample is stopped, the electromagnetic valve SV2 provided on the diluting solution supplying pipe 31 opens to supply the diluting solution to the diluting chamber 11. When the height of the liquid level from the bottom of the constant volume chamber 11a within the diluting chamber 11 reaches H , the light path R between the light source 41 and the light detector 4 is cut off by the liquid level. Therefore, since the

signal comes not to arrive at the light receiving part of the light detector 4, the light detecting signal from the light detector 4 becomes 0. By this, the electromagnetic valve SV2 is closed to stop the supply of the diluting solution. The state of the diluting apparatus shown in Fig. 9 at this time is shown in Fig. 11. In the case where the component to be measured is achromatic as with phosphoric ions and the like, a color former that forms a color in response to this component is infused at this point.

[0089]

After infusing the diluting solution and the color former as necessary, the electromagnetic valve SV5 is opened, and the air is jetted from the air jetting aperture 14a through the air supplying pipe 14 from the compressed air tank 7. The sample, diluting solution and color former added as necessary are stirred by this air to prepare the diluted sample. The state of the diluting apparatus shown in Fig. 9 at this time is shown in Fig. 12.

[0090]

After preparing the diluted sample, the electromagnetic valve SV5 is closed, and the supply of the air to the air jetting aperture is stopped to complete stirring.

[0091]

After completing stirring, the electromagnetic valve SV3 provided in the diluted sample discharging pipe 13, and the electromagnetic valve SV7 provided in the drain discharging pipe 51 are opened, the diluted sample inside of the diluting chamber is delivered to the measuring tank 5, the concentration of the object component is measured in the measuring tank 5, and the diluted sample is discharged from the drain discharging pipe 51

outside.

[0092]

After completing measurement in the measuring tank 5, the electromagnetic valves SV2, SV3, SV4, SV6 and SV7 open to supply the diluting solution from the diluting solution storing tank 3 to the diluting chamber 11, constant volume chamber 11a, sample discharging pipe 12, diluted sample discharging pipe 13, measuring tank 5 and drain discharging pipe 51, thereby cleaning the diluting chamber 11, constant volume chamber 11a, sample discharging pipe 12, diluted sample discharging pipe 13, measuring tank 5 and drain discharging pipe 51.

[0093]

Hereinafter, components of the diluting apparatus of the present invention are described in detail.

[0094]

In the diluting apparatus of the present invention, any diluting tank according to the present invention can be used as a diluting tank. As such a diluting tank, for example, the diluting tanks shown in Figs. 1 to 8 can be exemplified.

[0095]

As the sample supplying means, like the sample supplying means in the diluting apparatus shown in Figs. 9 to 12, sample supplying means having the sample liquid storing tank that temporarily stores the obtained sample, and the sample supplying pipe which is a pipe supplying the sample from this sample liquid storing tank to the diluting tank can be used. The electromagnetic valve can be inserted into the above-mentioned sample

supplying pipe as the sample supply stopping means, as shown in Figs. 9 to 12. Otherwise, as the sample supply stopping means, various valves such as a stop valve, gate valve, butterfly valve, ball valve, faucet and three-way valve can be used. These valves may be of manual type, or may be a valve actuated by electromagnetic power like the electromagnetic valve, or may be a valve actuated hydraulically or pneumatically. Alternatively, a pinchcock can be used instead of the above-mentioned valves.

[0096]

As the sample supplying means, in addition to this, in piping in which a liquid to be obtained as a sample flows, such as piping of circulating water in a thermal power plant or an atomic power plant, there may be provided a sample obtaining pipe that obtains the sample, and a sample returning pipe that returns the sample to the above-mentioned piping, and the sample supplying pipe, the above-mentioned sample obtaining pipe and the sample returning pipe may be connected by a three-way valve so that the flow path from the sample obtaining pipe can be switched between two paths; a flow path to the sample supplying pipe and a flow path to the sample returning pipe. In the sample supplying means of this aspect, the above-mentioned three-way valve corresponds to the sample supply stopping means.

[0097]

As in the diluting apparatus of the aforementioned Figs. 9 to 12, in the case where the sample tank has the sample discharging pipe, there may be employed a configuration in which the detector that detects the sample is provided in the sample discharging pipe, and when this detector detects that

the sample has passed through the sample discharging pipe, the signal from this detector actuates the sample supply stopping means to stop the supply of the sample.

[0098]

As the diluting solution supplying means, like the diluting solution supplying means in the above-mentioned embodiment, diluting solution supplying means having the diluting solution storing tank that stores the diluting solution, and the diluting solution supplying pipe connecting this diluting solution storing tank and the diluting tank can be used. An electromagnetic valve can be inserted as the diluting solution supply stopping means in the above-mentioned diluting solution supplying pipe, as in the aforementioned embodiment.

[0099]

As the diluted sample discharging means in the diluting apparatus of the present invention, like the diluted sample discharging means in the above-mentioned embodiment, an aspect having the diluting solution discharging pipe provided at the bottom of the diluting tank body is possible. Various valves such as an electromagnetic valve can be provided as the diluted sample discharge stopping means in the middle. As these valves, for example, various valves including the electromagnetic valve can be used, similar to those described for the sample supply stopping means and the diluting solution supply stopping means. For example, as in the example of the diluting apparatus shown in Figs. 9 to 12, the aforementioned sample discharging pipe can be connected to the measuring tank that measures the concentration of the component to be measured in the diluted sample.

[0100]

In the diluting apparatus of the present invention, means for detecting that the liquid level within the diluting chamber has reached a predetermined height may be provided. As such means, an apparatus that optically detects the liquid level, apparatus that mechanically detects the liquid level, apparatus that electrically detects the liquid level or the like can be used.

[0101]

As the apparatus that optically detects the liquid level, as shown in Figs. 9 to 12, an apparatus having a light source attached at a predetermined height, and a light detector provided on the opposite side of the above-mentioned light source across the diluting tank body can be exemplified. In this apparatus, as the light source, various light sources such as an incandescent lamp, fluorescent light, xenon lamp, light-emitting diode and various laser oscillators can be used. As the light detector, a light detector utilizing various light receiving elements, or a photoelectric tube can be used. In such a light detector, a current flows while light arrives, and the current stops when the light is cut off, which allows the liquid level to be detected.

[0102]

As the apparatus that mechanically detects the liquid level, an apparatus having a small float which floats on the liquid level in the diluting chamber, and a switch mechanically coupled to this float via a push stick, a link, or the like can be exemplified. In this apparatus, when the float rises to a predetermined position, the switch coupled to this float is turned off or

on, which allows the liquid level to be detected.

[0103]

In addition to that, there is an apparatus having a spring placed below the diluting tank and a switch turned off or on when a sinking amount of the diluting tank becomes a predetermined value. In this apparatus, since the spring is placed below the diluting tank, when the diluting solution is supplied to the diluting tank and the weight of the diluting tank reaches a predetermined weight, the sinking amount of the diluting tank also reaches the predetermined value, and at this time, the switch is turned off or on, which allows the detection of the liquid level having reached the predetermined height.

[0104]

As the apparatus that electrically detects the liquid level, for example, an apparatus having two electrodes opposed to each other, which are placed at a predetermined height within the diluting chamber, and an AC source that applies alternating current of a certain frequency to these electrodes can be exemplified. In this apparatus, when the liquid level reaches the predetermined height, the above-mentioned two electrodes are submerged in the liquid, and capacitance between the electrodes changes. The liquid level can also be detected by detecting this.

[0105]

In the diluting apparatus of the present invention, a configuration can be employed in which when these liquid level detecting apparatuses issue a signal indicating that the liquid level has been detected, the diluting solution supply stopping means operates to stop the supply of the diluting

solution. As such an apparatus, there is used an apparatus, for example, having an electromagnetic valve as the diluting solution supply stopping means, and the apparatus is configured such that this electromagnetic valve and the liquid level detecting apparatus are electrically coupled, so that an electric signal indicating that the liquid level has been detected, which is issued by the liquid level detecting apparatus, allows the electromagnetic valve to be closed.